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ABSTRACT

A study provided students with relevant background knowledge and tested the effects of this knowledge on two versions of a text. The two text versions were four original segments of text from a fifth-grade social studies textbook about the period leading to the American Revolution and their revised versions from an article in "Reading Research Quarterly." The revisions, which were designed to improve text coherence, resulted in improved comprehension. Subjects, 48 fifth graders, were presented with an instructional module designed to upgrade knowledge prior to reading one of the text versions. Results indicated that students who read the revised text recalled significantly more material and answered significantly more questions correctly than students who read the original text. Further, it appeared that the effects of background knowledge and more coherent text may be additive, that is, there may be separate effects of knowledge and coherent text. The results support the importance of the teacher's role in mediating learning from social studies text. (Four tables of data and two figures are included, and 29 references are attached.) (Author/MG)

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The Relative Contribution of Prior Knowledge
and Coherent Text to Comprehension

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Running Head: KNOWLEDGE AND TEXT CONTRIBUTIONS TO
COMPREHENSION

Submitted for Review.

Abstract

The purpose of the present study was to provide students with relevant background knowledge and test the effects of this knowledge on two versions of a text. The two text versions were four original segments of text from a fifth grade social studies textbook about the period leading to the American Revolution and their revised versions from Beck et al. (in press). The revisions, which were designed to improve text coherence, resulted in improved comprehension. In the present study 48 fifth graders were presented with an instructional module designed to upgrade their background knowledge prior to reading one of the text versions. The results replicated the findings of Beck et al. (in press) in that students who read the revised text recalled significantly more material and answered significantly more questions correctly than students who read the original text. Further, it appears that the effects of background knowledge and more coherent text may be additive, that is, there may be separate effects of knowledge and coherent text. Finally, the results support the importance of the teacher's role in mediating learning from social studies text.

The Relative Contribution of Prior Knowledge and Coherent Text to Comprehension

Learning, both in school and beyond, is heavily dependent on acquiring information from text. Research on text processing over the last two decades has greatly expanded understanding of what is involved in reading and learning from text. The current view of reading has shifted from that of lifting the message from a text to that of an active, complex process in which a reader draws on information from several sources concurrently to construct a representation of a text's message.

The constructivist orientation of recent research has highlighted the role of a reader's background knowledge. Research has emphasized that it is not only lack of knowledge about a topic that impedes comprehension, but that the extent of knowledge influences the quality of understanding that a reader can construct. Research by Voss and his colleagues (Chiesi, Spilich, & Voss, 1979; Means & Voss, 1985; Spilich, Vesonder, Chiesi, & Voss, 1979) and Chi and her colleagues (Chi, 1978; Chi, Feltovich, & Glaser, 1981; Chi, Glaser, & Reese, 1982; Chi & Koeske, 1983) has shown the advantage in comprehension for high knowledge versus low knowledge individuals.

Another influence on a reader's ability to acquire information from text is the way the text content is organized and explained. The concept of coherence has been used to describe the kind of organization of text that facilitates the reader's task. As such, coherence refers to the extent to which the sequencing of ideas in a text makes sense and the extent to which the language used to present those ideas makes the nature of the ideas and their relationships apparent.

Research on text has provided evidence of the relationship between coherence and the comprehensibility of a text. Studies that present readers with more and less coherent versions of text have shown that the more coherent versions yield better comprehension (Beck, McKeown, Omanson, & Pople, 1984; Beck, McKeown, Sinatra, & Loxterman, in press; Britton, 1990). The concept of coherence and its role in text comprehensibility is also an aspect of Anderson and Armbruster's (1984) notion of "considerate text."

Research Context for Studying the Contribution of Knowledge and Coherent Text

Advances in understanding the complexity of the reading process, particularly the role of the reader's knowledge and the characteristics of text that influence comprehension, provide a rich context for investigating instructional issues. This context was used as the research base underlying the development of a program of research on learning history from social studies textbooks. The present study, which looks at the effect of knowledge and text coherence, represents a culmination of this program of research. This research effort, which started with an analysis of textbooks (Beck, McKeown, and Gromoll, 1989), led to an investigation of students' prior knowledge (McKeown & Beck, in press) and then considered the effects of more and less coherent texts on students' comprehension (Beck et al., in press).

Analysis of textbooks. The analysis of content and content presentation in four widely used social studies programs (Beck et al., 1989) concluded that the presentation of history in the programs examined was not oriented toward helping young learners develop a coherent representation of various historical topics and periods. At a general level, there seemed to be two related reasons why this was so. First, the texts assumed an unrealistic variety and depth of

prior knowledge from target-age students. Second, the presentation of content was less than coherent. That is, the texts tended to present numerous facts, but there was little explanation of relationships among facts. As such, the texts require young learners to make many connecting inferences among events and ideas without much, if any, assistance.

Both issues--the unrealistic assumption of prior knowledge and the influence of textual coherence--were empirically examined in subsequent studies (McKeown & Beck, in press; Beck et al., in press). In both studies the topic selected for investigation was the period leading to the American Revolution, which traditionally is first encountered formally in the fifth grade curriculum. This topic was selected for study because of its face valid importance. That is, because the period embodies the principles upon which our nation is founded, its influence is enormous for subsequent learning in history, as well as other subject matters, and is strongly reflected in diverse aspects of American culture.

Investigation of prior knowledge. The McKeown and Beck (in press) study examined fifth graders' knowledge of the Revolutionary period to evaluate whether students had acquired the requisite knowledge that was assumed by the text. Although in the Beck et al. (1989) textbook analysis the investigators judged that the passages on the Revolutionary War assumed a good deal of knowledge, it is possible that students have accumulated that knowledge before instruction from such sources as reading, television, and general references to the period that exist in American society. Thus, to probe the extent of students' relevant knowledge, McKeown and Beck (in press) interviewed fifth graders just before they initially studied the Revolutionary period in school. The interview questions were based on two broad notions that Beck et al. (1989) indicated

were largely assumed by the textbooks examined in their analysis and which they suggested are necessary for learning about the period: the role of England in the colonists' struggle for independence and ideas about representative government.

Students' responses to the interview questions were used to characterize the knowledge that target learners bring to texts about the Revolutionary period and to assess the match between what students know and what the texts assume. The results suggested that although many students had some familiarity with events and issues related to the period, for most students this knowledge was of a vague nature and very often contained inaccuracies. Thus, to a large extent, the results supported the hypothesis that knowledge assumed by the texts was not well represented in students' repertoires.

Comparison of more and less coherent text. The second problematic issue identified in the Beck et al. (1989) analysis was the less than coherent nature of the textual material. This problem was investigated by developing revised versions of textbook passages and examining student's comprehension of revised and original texts (Beck et al., in press). The revised versions of text were developed within a cognitive processing orientation which involved simulating the process of a reader's interaction with a text. This simulation took into account a range of findings from text processing research about what causes reader/text interactions to proceed or to break down (see for example, Graesser & Clark, 1985; Just & Carpenter, 1987; Kieras, 1985; Perfetti, 1985; Trabasso, Secco, & van den Broek, 1984). The goal of the revisions was to create a text that would assist the reader in connecting pieces of text information and combining it with prior knowledge to develop a coherent representation. Toward this goal, the revised text was based on a causal sequence of events

with the information presented in such a way as to expose the reasoning that connects a cause to an event and an event to a consequence.

At a general level, the revisions were intended to establish textual coherence by clarifying, elaborating, explaining, and motivating important information, and making relationships explicit. Because decisions underlying the revisions were so strongly tied to the specific content we present a summary of the changes in terms of the content. (A complete description of the revisions appears in Beck et al., 1989.) The text we used comprised four segments, the French and Indian War, No Taxation without Representation, the Boston Tea Party, and the Intolerable Acts.

The original text on the French and Indian War failed to provide explanations of the motivation and consequences of the war between Britain and France and failed to make explicit the colonies' relationship to Britain. The goal of the revisions for this segment was to present an explicit framework for the war (who fought and why, what resulted) and lay the groundwork that would provide a setting for conflict between Britain and the colonies.

The original No Taxation without Representation text segment failed to communicate the cause of the colonists' distress over taxes, in large part because it did not explain the concept of representation. The revised text explained that British citizens elected people to Parliament but the colonists could not vote in those elections and that this was the basis for the colonists' anger at being taxed by Parliament.

The original text about the Boston Tea Party, although it gave an adequate portrayal of the event itself, failed to explicate its role as a protest over Britain's taxes. The revised text explained that the colonists' anger over paying for tea stemmed from the tax on the tea which is what led to colonial protests.

Finally, the original text on the Intolerable Acts did not adequately portray the desperate situation created in Boston by Britain's laws that were intended to punish colonists for the tea party. The revised text clearly detailed those punishments and explained the consequences for colonial life in Boston. The revisions were intended to help readers understand the causes of conflict between Britain and the colonies and to prepare students for where the intensifying conflict was leading.

The students who read the revised text showed significantly better comprehension than those who read the original text, and this included greater awareness of the role of central events in the causal sequence. However, both groups' performance indicated that they still had considerable difficulty in understanding the text. One possible hypothesis for the comprehension difficulty is the lack of background knowledge identified by McKeown and Beck (in press). It is reasonable to assume that the background knowledge problems identified in McKeown and Beck were applicable to the population used in the Beck et al. (in press) study because the subjects in both studies were from the same small stable school district with a traditional and consistent social studies curriculum.

The Present Study

The purpose of the present study was to provide students with relevant background knowledge and test the relative effects of this knowledge on more and less coherent versions of a text. Thus, the present study, in conjunction with the series of studies reviewed above, provides a means of examining the relative effects of knowledge and coherence on comprehension. The nature of the interaction between knowledge and text structure--of which coherence can be considered an aspect--was the focus of a recent review by Roller (1990). In

discussing conflicting findings about the role of knowledge and structure in text comprehension, Roller asserts that an important goal for text research is to examine the effects of both world knowledge and text structure variables on students' comprehension. As such, the program of research discussed here coincides with Roller's call for research on the intersection of the effects of knowledge and text structure.

In the present study, background knowledge was provided to all students through a carefully crafted experimenter led presentation. Students were then assigned to one of two text conditions: the original textual materials from a fifth grade social studies textbook or the revised version of the text materials. Given the finding that more coherent text led to better comprehension (Beck et al., in press), the question posed in the present study was whether providing relevant background knowledge before reading would compensate for the less coherent text, or whether an advantage would still be demonstrated for the coherent text.

Method

Subjects

Subjects for this study were 48 fifth graders from an elementary school in a middle class small public school district in a northern state. (This was the same school district as the one used in the previous two related studies discussed above). Parental permission was obtained for all students who participated.

Subjects were rank ordered based on their reading comprehension test scores on the Metropolitan Achievement Test (Prescott, Balow, Hogan & Farr, 1984). Every other student in the distribution of reading comprehension scores was then assigned to one of the two groups for the text conditions. This resulted

in comparable means and standard deviations of comprehension scores for the two groups (original group, 66.46, SD = 23.52; revised group, 66.42, SD = 23.62).

Materials and Procedures

All students received a prepared instructional module designed to provide relevant background knowledge for understanding the text. One of the authors presented the knowledge module, using a written script, to students in their regular social studies classes. An equal number of students in each of the two social studies classes was assigned to each text condition.

Rationale for knowledge module. The content that was presented focused on establishing and distinguishing the major agents of the Revolutionary period, the British and the colonists. This content was selected, first, because of its role as background for the sequence of events to be presented in the text and, second, because of evidence that such information would not typically be in students' repertoires.

The content of the knowledge module identified the colonies as belonging to Britain; portrayed the colonists as beginning to develop an identity of their own, separate from being British; and discussed that the colonists, although under British rule, were allowed to make some of their own laws. Each of these three concepts was included to provide students with an understanding of significant features of the political and social context that existed prior to the Revolution. That is, it seems that if students failed to understand that the colonies were British, they would have little basis to understand what the colonies might want freedom from; further, the emergence of a distinct "American" identity is an important feature that motivates the desire for independence; and finally, some familiarity with governmental rights of the

colonies is needed to understand why they might reject taxation without representation and what denial of self-government under the Intolerable Acts would mean.

Evidence that students might lack understanding of the selected content comes from analysis of the textbooks (Beck et al., 1989) and from an empirical study of students' knowledge about the Revolutionary context, agents, and events (McKeown & Beck, in press). From the analysis of textbooks, it was found that Britain's possession of the colonies was not strongly established; the concept that colonists were beginning to develop an identity as Americans was almost completely lacking; and colonial self-government was barely given mention. From the study of relevant knowledge of fifth graders just before instruction on the Revolutionary period, it was found that only about 10% of the students related the 13 colonies to Britain, about a third of the students named Britain as a participant in the Revolutionary War, and students lacked understanding that the colonies had some powers of self-government.

Presentation of the knowledge module. To establish the purpose for the lesson, students were told that because they would soon be reading and learning about the American Revolution, which was described as "a war that the American colonists fought for their independence against Britain over two hundred years ago," they were going to talk about some things that might help them understand that time in history; specifically they were going to talk about some of the people and places that were involved in this period.

The module began by establishing five geographic and/or political entities, North America, Britain, France, Massachusetts, and Boston, that are referred to in the text and about which students evidenced confusion (Beck et al., in press). A component of the instruction aimed at introducing these entities

and relating them to what students might know about their existence today. To accomplish this purpose, some map work was done, and then the experimenter introduced two side by side charts. One was titled "Today, about 200 years after the Revolutionary War," the other was titled "Before the Revolutionary War, between about 1760 and 1775." Under each title, the five entities were printed down the side of the charts. The chart contained descriptors for each of the entities which were covered when the chart was first introduced.

Through a series of questions, the experimenter established the entities in terms of what they are today, and what they were before the Revolutionary war, uncovering each descriptor as it was discussed. For example, on the "Today" chart, Britain was described as, "A country 3,000 miles away from North America. Sometimes Britain is called England," and on the "Before the Revolutionary War Chart" as "The country that owned the 13 original colonies." When all the descriptors were uncovered, students were encouraged to engage with the information by using it to answer questions such as, "Were the 13 original colonies near Britain? (The relevant information on the charts was that the 13 original colonies were in North America and that Britain is 3,000 miles away from North America).

The first portion of the module ended with a summary emphasizing that the 13 colonies were owned by the British, and in fact, before the Revolutionary War, the 13 colonies were considered part of Britain, even though they were far away. Students were told that the discussion would now turn to "the people who lived in the 13 colonies, the people we call colonists." The intent of this section was to develop the notion that over the years the colonists were losing their British identity and developing an American identity.

To do so, first the experimenter told the students that many of the people who came to the colonies in the 1600's were British. And even though they lived far away from Britain, they felt British. "Another way of saying that is: the colonists had a British identity. Someone's identity is what they feel they are. You have an American identity because you feel American." The experimenter explained that as years went by, a lot of the colonists began to lose their British identity; began to feel separate from the British, and they even began to call themselves Americans.

To encourage students to engage with the information, the experimenter asked, "Why do you think there was this change?" and provided prompts and questions toward developing the notion that the colonists had established a very different life style from that in Britain ("Let's think of what the colonists had to do when they first came over here. Did they have houses to move into? Were there stores to go to?"). Attention was also brought to the influence of the passage of time in changing the colonists' identity, (e.g. "Let me tell you that a lot of time passed--about a hundred years--between when people started coming to the colonies and the middle 1700's, the time we are talking about now. Why would that help bring about changes in how the colonists felt?")

The final portion of the identity section involved the experimenter reading descriptions of people and the students deciding whether the individual would be more likely to have a British or American identity. For example:

My name is Samantha Stevens. I spent many years of my life getting a school going in our town and helping to teach the children. I am very proud of the work I've done and of how much our children learn. In Britain, only those who can afford it send their children to school. That used to seem fine to me. But here everyone goes to school--and I really think that is the way it should be! What is Samantha's identity?

Next students were told that having thought a little about the people who lived in the colonies, they were now going to think a little about how the 13 colonies were governed. To start this section the experimenter posed the question, "Who decided how things were run in the 13 colonies--was it the British, or was it the colonists, or was it both--the British and the colonists." After the students made their choice, the experimenter established that both the British and the colonists were involved in running the colonies.

The experimenter explained that the 13 colonies "weren't united into one country. Each of the 13 colonies had their own little government" and that an important part of that government was something called a colonial assembly which made many of the rules and laws for the colony. It was also established that people became assemblymen through elections.

Students were then told that, "in addition to the laws the assemblies made, the government over in Britain could make rules and laws that all the colonies had to follow. . . . So the colonies had some self-government, but they did not have complete self-government." The final governmental information presented to the students was about Britain having a king and parliament, which was where the laws were made, "something like our Congress."

The last activity, intended to further reinforce the distinctions between the colonists and the British, involved "thinking a little more about the different ways that the British and the colonists acted and thought." Here the experimenter introduced a chart that had on one side an illustration of some British characters, including King George, and on the other side some colonial characters. She then read some "quotes" that were explained as, "something that someone in one of these groups might say" and the students were to decide whether it was probably said by someone in the British group or

someone in the colonial group. For example, "I vote for people who go to the Massachusetts Assembly." "I can make laws for all the colonies." "My grandparents sailed 3,000 miles across the Atlantic Ocean." "I vote for people in Parliament."

In summary, the content in the 35 minute knowledge module was based on information identified as important background information that had been assumed by the textbook presentation. It is important to emphasize that the material in the instructional module did not present the sequence of events described in the text, but introduced major agents and prerequisite concepts needed to construct a representation of that sequence from the text material.

Administration of text conditions. The procedures for administering the two text conditions were identical to those used in Beck et al. (in press). Students were presented the text materials in individual sessions with an examiner. The examiner followed a written script that included a brief introduction, instructions, recall prompts, and short answer questions. Each student read the text silently in four sections, one section at a time (i.e., French and Indian War, No Taxation Without Representation, Boston Tea Party, and Intolerable Acts). Students were asked to think of the sections as passages from their social studies book. When students completed each of the four sections, they were asked to tell in their own words what the section was all about. Then students were asked a series of open-ended questions. The recalls and answers to questions were tape recorded and later transcribed for scoring.

Dependent Measures and Scoring

The dependent measures and scoring schemes used in this study were the same as those used in Beck et al. (in press). They will be described briefly below. For complete information the reader is referred to Beck et al. (in press).

Dependent measures. Measures of recall and questions were used to assess students' comprehension of the texts. Because young students' recall protocols of unfamiliar content tend to be rather limited, an extensive set of questions was developed for each passage. The questions, which were open ended in format, focused on the sequence of events and the relationships among the people and events described in the text. For example, questions for the French and Indian War text segment queried: who fought the war, where the war took place, why there was a war, who won the war, and what was achieved by winning.

Scoring. Recall protocols were scored using the same textbase developed for Beck et al. (in press). This scoring procedure was based on a narrative analysis technique developed by Omanson (1982) and used in previous work (Beck et al., 1984; Beck, Omanson, & McKeown, 1982). Omanson's analysis identifies clauses that portray an event or state as content units. The analysis was adapted for use with expository text which resulted in units that were often smaller than clauses. The procedures for developing the text base involved dividing the text into clausal units, establishing separate units for any clause or phrase that represented a distinct state, event, location, or qualifier. Because of the elliptical nature of the original text, some implied units were added where inferences were deemed necessary for understanding.

Procedures for scoring recalls. Each student's recall was scored for the gist of each text unit. Scoring was done by one of the researchers and the

scoring procedure has been shown to be reliable at 91% agreement (Beck et al., in press).

Procedures for scoring questions. Questions were scored on the basis of model answers developed by the investigators. Of the 34 questions across the four segments, 28 were scored either 0 or 1. Half credit was possible for the remaining 6 questions. As with recall, scoring was done by one of the researchers and was shown to be reliable at 94% agreement (Beck et al., in press).

Results

The major question in the present study was whether the improved recall and question performance found for readers of the revised text in Beck et al. (in press) (hereafter referred to as the Revision Study) would still be evident or whether upgrading background knowledge would diminish the comprehension advantage for the revised text. Stated most directly, "Does making available relevant background knowledge compensate for a poor text?" Because one of the analyses to be reported here involves comparisons between the findings from the Revision Study and the present study, this section starts with a brief review of the former study.

The Revision Study

The primary question in the Revision Study was whether the revised text produced better comprehension than the original text. As Table 1 indicates, the results of this study showed that students who read the revised text recalled a greater number of content units from the text and answered more questions correctly than the students who read the original text. These differences were significant.

Insert Table 1 about here

The results also showed that there were significant differences in comprehension performance across the four text segments. The No Taxation text proved to be the most difficult for students as it showed the lowest comprehension performance whereas the Boston Tea Party segment showed the highest comprehension performance of the four passages. Additionally, qualitative results showed that students who read the revised text demonstrated a better understanding of key points in the text. For example, more students who read the revised text understood how the colonists felt about the taxes, and why the colonists threw tea into Boston harbor.

Present Study: Effects of Knowledge and Text Revision

Comprehension effects. As in the Revision Study, a primary question of interest in the present study was whether the revised text would produce better comprehension than the original text. However, since relevant background knowledge was made available to all students in the present study, the question about the influence of the nature of the text on comprehension was asked in the context of upgraded background knowledge.

The data for recall of units common to both texts and the answers to questions were examined in separate mixed design analyses of variance (ANOVA) using text type (original versus revised) as the between-subject factor and passage segment (French and Indian War, No Taxation, Boston Tea Party, and Intolerable Acts) as four levels of a within-subjects factor.

Insert Table 2 about here

Table 2 shows that students who read the revised text recalled a greater percentage of content units than students who read the original text, and this difference was significant [$F(1, 46) = 7.59, p < .01$]. This comprehension advantage was demonstrated in students' question answering performance as well. Table 2 also shows that students who read the revised text answered more questions correctly. This difference was also significant [$F(1, 46) = 6.08, p < .05$]. These findings essentially replicate the findings of the Revision Study in that they show a comprehension advantage for the revised text materials.

A comparison of the performance of students in the Revision Study (see Table 1) to that of students in the current study (see Table 2) shows that comprehension in the current study is improved for all students and thus suggests that both text revision and upgraded background knowledge contribute to text comprehension. The possibility of an independent contribution of both text revision and knowledge will be explored later in other analyses. We first consider the effects by passage.

Passage effects. There were significant differences in comprehension performance among passages for both recall and questions [recall $F(3, 138) = 34.70, p < .01$; questions $F(3, 138) = 7.71, p < .01$]. There was also a significant text condition by passage interaction for both recall [$F(3, 138) = 5.37, p < .01$] and question performance [$F(3, 138) = 5.20, p < .01$]. (Figures 1 and 2 graphically depict the data in Table 2.)

Insert Figures 1 and 2 about here

As can be seen in Figure 1, for both the original and the revised groups, the lowest recall performance was for the No Taxation text segment and the highest was for the Boston Tea party. These findings are consistent with that of the Revision Study. The significant interaction reveals, however, that the advantage for the revised group is not equal across the four text segments. The difference between the two groups' recall performance on the Intolerable Acts segment is more than twice that of the differences between the other three segments.

One possible explanation for the greater differential in performance between the two groups on the Intolerable Acts segment, which was the last segment in the sequence, is that the combined advantage of the knowledge module and the revised text may have been cumulative. That is, because each text segment builds somewhat on information from the previous segments, the increased comprehension of the first three segments may have contributed to a boost in performance for the revised group on the last text segment. Conversely, gaps in understanding may have had a cumulative effect on the performance of the original text group.

The results for the question performance show a somewhat different pattern. For the original group the lowest question performance was for the Intolerable Acts segment and the highest performance was for the Boston Tea Party. While for the revised group, the lowest question performance was for the French and Indian War and the highest was for the Boston Tea Party. Further, as indicated by the interaction depicted in Figure 2, the difference in

performance of the two groups on the French and Indian War passage is not comparable in magnitude to the comprehension advantage seen for the revised group on the other three passages.

These patterns described above are somewhat different from those seen in the Revision Study and may be a consequence of the interaction of the strong schema for Britain and the colonies established in the knowledge module and the revised text's more extensive foreshadowing of the upcoming Revolutionary conflict. Because the most salient part of the discrepant patterns is the relatively poor performance of the revised group in the present study on the questions for the French and Indian War segment, we looked at the responses to the eight individual questions and found that the revised group had relatively poor performance on three of the questions. Specifically, the questions concerned who had the land before the war, what Britain got from the French and Indian War, and how the colonies were getting along with Britain right after the war. As for who had the land before, the most common incorrect response was the Indians, and we can not speculate as to why this occurred.

In regard to the two other questions, however, the revised group's responses indicated that they may have accessed their knowledge about the British and colonial antagonism gained from the instruction too early in the text sequence. That is, they often suggested that the British had won the colonies as a result of the French and Indian War and that the British and colonists were not getting along well after that war.

Comparison of Knowledge and Text Effects

The question of whether providing prerequisite background knowledge can compensate for a poor text can be addressed by comparing the performance of students in the Revision Study who read the two text versions

without the background knowledge module to those students in the present study who read the two text versions after the knowledge module had been presented.

An examination of the means from the Revision Study and the present study (refer again to Tables 1 and 2) suggests that students who read the original text and received the background knowledge instructional module did perform better than those who read the original text and did not receive the instructional module. Those students who read the revised text and were provided with background information also appear to do better than those students who read the revised text without background knowledge. However, the text effect on comprehension was still evident in the present study, even with background knowledge having been made available to students in both text conditions. Therefore, it appears that the effects of background knowledge and more coherent text may be additive, that is, there may be separate effects of knowledge and coherent text.

Test of separate effects of knowledge and text coherence. To examine whether this is the case, data from both studies were combined in a series of regression analyses.¹ The purpose of these analyses was to determine whether both coherent text and background knowledge account for unique and significant portions of variance in text comprehension performance.

In order to assess the relative contribution of knowledge and coherent text to the prediction of comprehension performance, stepwise regression analyses were conducted using recall and question answering performance as criterion variables and knowledge condition, text coherence condition, and reading comprehension test scores as predictor variables. Comprehension test scores were included in the regression equation in order to separate the effects

of instruction and text coherence from that of reading ability. The variables were entered in a stepwise fashion as it was not apparent apriori which of these variables would account for more variance in performance.

Insert Table 3 about here

Table 3 presents the predictor variables, the criterion variables, the proportion of variance accounted for, and the statistical value of the prediction equations. As can be seen in the table, reading comprehension test scores, text coherence condition, and knowledge condition each predict a significant amount of variance in recall performance, accounting for a total of 37% of the variance. The order of the variables in the prediction equation reveals that after the variance due to ability is accounted for, coherent text accounts for an additional 9% of the variance. Knowledge then contributes a significant, but smaller (3%) proportion of variance.

When question performance was used as the criterion variable, only reading comprehension test scores and text coherence condition were significant predictor variables, accounting for a total of nearly 39% of the variance. The lack of variance accounted for by the background knowledge instructional module in question performance can be attributed to the revised group's performance on the French and Indian War (see Figure 2). As noted earlier, it appeared that the emphasis in the knowledge module on British and colonial identity in combination with the strong foreshadowing of the Revolution in the revised text influenced students' responses. However, when the data for the French and Indian War were not included in the regression analysis, the knowledge condition did account for a significant proportion of variance in

question performance (3%) [$F(3, 129) = 30.97, p < .01$] and the pattern of findings for the question data matches that of the recall data.

Qualitative analysis of question responses. Some insight may be gained into the kind of comprehension advantage fostered by prior knowledge and text coherence by examining the pattern of responses to questions generated by students in the Revision Study and the present study.

The questions for each text segment were designed to tap the sequence of events and the relationships among the agents and events described in the text. Thus examining the pattern of responses can reveal how successful students in each group were in developing a representation of the causal chain of events.

Table 4 presents the questions for the No Taxation, Boston Tea Party, and Intolerable Acts text segments and the percent of each group that correctly answered each question for both the Revision Study and the present study. Questions on the French and Indian War are not included because the question response pattern diverged from that of the other segments, and our hypotheses for that have already been discussed. In order to demonstrate how students in each group responded to the sets of questions, the table also presents a model response for any question correctly answered by 50% or more of the students in each group. With the selection of 50% as the criterion, reading down each column conveys some sense of the understanding that students in each group typically constructed.

Insert Table 4 here

Two trends that can be seen on the table are of particular note. The first is that the revised group in the present study (Revised 2) has the greatest number of questions that meet the 50% criterion. Notably, this advantage is shown for information that represents the issues and principles underlying the colonists' struggle with Britain and growing colonial unity. Specifically, more Revised 2 students seem to have some grasp of what No Taxation Without Representation meant and a greater understanding that the Boston Tea Party represented a protest over British taxes. In the Intolerable Acts segment, more Revised 2 students understood what it meant to be denied self-government and the reactions of the other colonies to the situation created by Britain's punishment of Massachusetts--that is, other colonies feared similar British actions, and they rallied to Boston's aid with food and supplies.

The other trend that can be noted on Table 4 is that the revised group in the Revision Study (Revised 1) answered several more key questions at the 50% criterion than either of the two groups who read the original text (Original 1 and Original 2). Specifically, in the Boston Tea Party segment, the students in Revised 1 seemed more likely to understand that the colonists refused to buy or serve tea even after Britain lowered its price, and, in the Intolerable Acts segment, that it was the British who closed Boston Harbor, creating shortages of supplies for the Massachusetts colony. These are important concepts because of their role in portraying the growing conflict between Britain and the colonies.

It is important to stress that all this information represented as question responses was available from the text. Yet an adequate representation of the sequence of events described in the text was quite difficult for young students to achieve without upgraded text coherence and instructionally provided background knowledge.

Discussion

In investigating the relative contribution of knowledge and text coherence, we anticipated either of two possible outcomes. The first was that upgrading students' background knowledge would diminish the comprehension advantage for the revised text. The rationale for this possibility is that given appropriate background knowledge, students could bring that knowledge to bear on the rather elliptical nature of the original text and make the connecting inferences needed to bring coherence to the material. This line of thinking coincides with Roller's (1990) discussion of the interaction of text structure and background knowledge. That is, clear and logical structure of a text--which can be likened to our concept of coherence in many respects--is most useful to readers encountering text in moderately unfamiliar domains. Thus it might be posited that the knowledge module would have provided enough familiarity with the content to override the need for the kind of structural support present in the coherent text.

The other possibility was that background knowledge in addition to more coherent text would result in better comprehension than coherent text alone. The notion here is that two sources of support, coherent text and background knowledge, would provide greater enhancement of comprehension than a single source, either upgraded knowledge or more coherent text.

As is clear from the results, it was this second possibility that prevailed. The students who read the revised text were able to utilize the knowledge gained from the background knowledge instructional module to focus on and remember the most important information from the text. This was particularly evident in the qualitative analysis of the data from responses to questions. The revised group was most successful in responding to the questions that were key

to establishing a mental model of the situation described by the text; their answers indicated some grasp of the principles motivating the colonists' actions and Britain's reactions and of the potential gravity of the escalating situation.

The students who read the original text, although they received the same background information, were less able to exploit the advantage provided by that information. It seems that the nature of the original text prevented students from bringing their knowledge to bear in constructing meaning from the text. The effect of upgraded knowledge on the readers of the original text seems to be the other side of the coin to Roller's (1990) argument that text structure has differential effects for different levels of knowledge. That is, the present results suggest that background knowledge is most useful if the text is coherent enough to allow the reader to see the connections between the text information and their knowledge so that the knowledge can be combined with the text information to create a meaningful representation.

Regarding the effect on text comprehension of the knowledge provided by the background knowledge instructional module, one additional finding begs further comment. The finding, which was presented earlier, is that of the comparatively poor performance of the revised group on the questions about the French and Indian War. As was mentioned previously, the hypothesis is that this finding is traceable to the emphasis created in the instruction on the diverging identities of the actors in the Revolutionary War, which likely drew attention away from the specifics of the French and Indian War. This finding is worthy of note because it represents an example--created inadvertently--of a phenomenon that is currently prominent in the literature on background knowledge. The phenomenon is that of background knowledge overriding text information such that readers recall text or respond to questions with

information from their knowledge base, even though it is not supported by--and in some cases even contradictory to--the text (Alvermann, Smith, & Readence, 1985; DiSessa, 1983; Dole & Smith, 1987; Lipson, 1982; Marshall, 1989; Schoenfeld, 1985). In the case at hand, it appears that students depended on either their newly acquired or their newly activated schema about the Revolutionary period to answer questions about the earlier war presented in the text.

The research reported here also addresses the issue of the contribution of textbooks to social studies learning, particularly in relation to the teacher's role in mediating text information. Elementary text based lessons--be they in reading, science, or social studies--as represented in the teacher's manuals that accompany textbook series are initiated with a preparation component. Preparation components are teacher-initiated activities, often teacher-led discussions through which the teacher attempts to provide the students with skills and background knowledge related to the upcoming textual material. The information provided might include, for example, a context for a story, the meanings of some vocabulary, or explanation of a concept. It is conventional wisdom that the teacher has a significant role in "preparing" elementary students for the textual materials they will encounter, although there are differences in what is recommended across grade levels, textbook series, and subject matters, as well as individual differences among teachers.

One such difference across subject matters is apparent in even a cursory comparison of teacher's manuals for reading and social studies; the suggestions in the preparation component for social studies are far less extensive than those found in reading textbook series. The more extensive preparation components for reading selections may have developed because,

given that reading is a process and not a subject matter, what students can read about in a reading program can be chosen from the multitude of topics in the world (Beck & McKeown, 1989). Thus, because reading programs tend to be a smorgasbord of content with frequent, often daily, changes in topic, there is obvious need to provide background. In contrast, the less extensive preparation component in the social studies teacher's manuals may have its roots in the notion that a content area textbook is by definition sequentially developed so that early chapters serve as background for subsequent chapters.

The results of this study in combination with those of the Revision Study suggest that the notion of sequenced content as background, at least for social studies texts as they are now written, is a fallacy. Previous text content as background, represented in the original text condition of the Revision Study, fell far short of preparing students for understanding text content about events leading to the Revolutionary War. This result demonstrates the need for teacher intervention, and rather substantial intervention at that. As discussed in Beck et al. (in press), the original group received regular classroom instruction accompanying the content leading up to the tested material, which included teacher intervention at least at the level prescribed in the teacher manual.

Another wrinkle in the prescription of teacher intervention is shown by virtue of the performance of the two groups in the present study. That is, the original textbook passages, coupled with fairly extensive teacher intervention to provide background knowledge, yielded comprehension that was below that of students who received the preparation component and the revised text. This result counters another argument sometimes put forth in the debate on textbooks; that is, efforts to make textbooks more coherent are unnecessary because the teacher fills in much information which will make up for many gaps

in the text material. As the research reported here has shown, extensive preparation to provide background knowledge did not compensate for the inadequacies of the text; there was still a substantial advantage for the revised text.

This study has shed some additional light on the contribution to text comprehension of two important components of that process, background knowledge and text coherence. As Roller (1990) has pointed out, text structure and background knowledge interact in their effect on comprehension. Knowledge of varying degrees can compensate for varying levels of structure--or, in the present study, coherence. Similarly, greater coherence can compensate for some knowledge gaps. Our portrayal of interaction is one in which both variables are individually effective, but neither variable can completely compensate for inadequacies in the other.

References

- Alvermann, D. E., Smith, L. C., & Readence, J. E. (1985). Prior knowledge and comprehension of compatible and incompatible text. Reading Research Quarterly, 20(4), 420-436.
- Anderson, T. H., & Armbruster, B. B. (1984). Content area textbooks. In R. C. Anderson, J. Osborn, & R. J. Tierney (Eds.), Learning to read in American schools, (pp. 193-224). Hillsdale, NJ: Erlbaum.
- Beck, I. L., & McKeown, M. G. (1989). Expository text for young readers: The issue of coherence. In L. Resnick (Ed.), Knowing, learning, and instruction: Essays in honor of Robert Glaser (pp. 47-66). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Beck, I. L., McKeown, M. G., & Gromoll, E. W. (1989). Learning from social studies texts. Cognition and Instruction, 6, 99-158.
- Beck, I. L., McKeown, M. G., Sinatra, G. M., & Loxterman, J. A. (in press). Revising social studies text from a text-processing perspective: Evidence of improved comprehensibility. Reading Research Quarterly.
- Beck, I. L., McKeown, M. G., Omanson, R. C., & Pople, M. T. (1984). Improving the comprehensibility of stories: The effects of revisions that improve coherence. Reading Research Quarterly, 19(3), 263-277.
- Beck, I. L., Omanson, R. C., McKeown, M. G. (1982). An instructional redesign of reading lessons: Effects on comprehension. Reading Research Quarterly, 17(4), 462-481.
- Britton, B. K., (1990). Improving learning from instructional texts by rewriting to induce linking mental operations. Paper presented at American Educational Research Association meeting, Boston, MA.

- Chi, M. T. H. (1978). Knowledge structures and memory development. In R. S. Siegler (Ed.), Children's thinking: What develops? (pp. 73-96). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Chi, M. T. H., Feltovich, P. J., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. Cognitive Science, 5, 121-152.
- Chi, M. T. H., Glaser, R., & Reese, E. (1982). Expertise in problem solving. In R. Sternberg (Ed.), Advances in the psychology of human intelligence (Vol. 1) (pp. 7-75). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Chi, M. T. H., & Koeske, R.D. (1983). Network representation of a child's dinosaur knowledge. Developmental psychology, 19, 29-39.
- Chiesi, H. L., Spilich, G. J., & Voss, J. F. (1979). Acquisition of domain-related information in relation to high and low domain knowledge. Journal of Verbal Learning and Verbal Behavior, 18, 275-290.
- Dole, J. A., & Smith, E. L. (1987, December). When prior knowledge is wrong: Reading and learning from science text. Paper presented at the meeting of the National Reading Conference, St. Petersburg, FL.
- di Sessa, A. (1983). Phenomenology and the evolution of intuition. In D. Gentner & A. L. Stevens (Eds.), Mental models. Hillsdale, NJ: Erlbaum.
- Graesser, A. C., & Clark, L. F. (1985). Advances in discourse processes: Vol. 17. Structures and procedures of implicit knowledge. Norwood, NJ: Ablex Publishing Corp.
- Just, M. A., & Carpenter, P. A. (1987). The psychology of reading and language comprehension. Rockleigh, NJ: Allyn and Bacon, Inc.
- Kieras, D. E. (1985). Thematic processes in the comprehension of technical prose. In B. K. Britton & J. B. Black (Eds.), Understanding expository text:

- A theoretical and practical handbook for analyzing explanatory text (pp. 89-107). Hillsdale, NJ: Erlbaum.
- Lipson, M. Y. (1982). Learning new information from text: The role of prior knowledge and reading ability. Journal of Reading Behavior, 14(3), 243-261.
- Marshall, N. (1989). Overcoming problems with incorrect prior knowledge: An instructional study. In S. McCormick & J. Zutell (Eds.). Cognitive and social perspectives for literacy research and instruction: Thirty-eighth yearbook of the National Reading Conference. (pp. 323-344). Chicago, IL: National Reading Conference.
- McKeown, M. G., & Beck, I. L. (in press). The assessment and characterization of young learners' knowledge of a topic in history. American Educational Research Journal.
- Means, M. L., & Voss, J. (1985). Star Wars: A developmental study of expert novice knowledge structures. Journal of Memory and Language, 24, 746-757.
- Omanson, R. C. (1982). An analysis of narratives: Identifying central, supportive, and distracting content. Discourse Processes, 5, 119-224.
- Perfetti, C. A. (1985). Reading ability. New York: Oxford University Press.
- Prescott, G. A., Balow, I. H., Hogan, T. T., & Farr, R. C. (1984). Metropolitan achievement tests. Cleveland, OH: The Psychological Corp. Harcourt Brace Jovanovich, Inc.
- Roller, C. M. (1990). Commentary: The interaction of knowledge and structure variables in the processing of expository prose. Reading Research Quarterly, 25(2), 79-89.

Schoenfeld, A. H. (1985). Mathematical problem solving. New York: Academic Press.

Spilich, G. J., Vesonder, G. T., Chiesi, H. L., & Voss, J. F. (1979). Text processing of domain-related information for individuals with high and low domain knowledge. Journal of Verbal Learning and Verbal Behavior, 18, 275-290.

Trabasso, T., Secco, T., & van den Broek, P. (1984). Causal cohesion and story coherence. In H. Mandl, N. L. Stein, & T. Trabasso (Eds.), Learning and comprehension of text (pp. 83-111). Hillsdale, NJ: Erlbaum.

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Footnotes

¹ The rationale for combining these two sets of data in the same analysis is based on the similarities of the two populations. Subjects from the present study were from the same school district and had the same social studies teacher as the fifth graders in the Revision Study. They used the same social studies textbook and were at the same point in their instruction when the study was conducted as were the fifth graders from the Revision Study. Further, reading comprehension test score means indicate that these two populations were comparable in ability (Revision Study = 61.6, SD = 22.3, Present Study = 66.44, SD = 23.3).

Table 1

Mean Percent of Units Recalled and Questions Answered Correctly by Students in the Revision Study (Beck et al., in press).

	Recall ^a		Questions ^b	
	Original	Revised	Original	Revised
French & Indian War	11.3	14.6	30.8	50.8
No Taxation	8.3	13.0	22.3	38.2
Boston Tea Party	21.6	26.6	41.8	61.6
Intolerable Acts	13.1	17.9	24.3	45.5
Total	13.6	18.0	29.9	49.1

^aThe number of units for each text segment was 38, 38, 27, 21 respectively.

^bThe number of questions for each text segment was 8, 9, 8, 9, respectively.

Table 2

Mean Percent of Units Recalled and Questions Answered Correctly by
Students in the Present Study.

	Recall ^a		Questions ^b	
	Original	Revised	Original	Revised
French & Indian War	13.3	19.3	40.6	42.7
No Taxation	11.4	15.4	33.6	47.5
Boston Tea Party	26.2	33.2	50.8	63.0
Intolerable Acts	14.7	31.5	29.2	60.9
Total	16.4	24.8	38.5	53.5

^aThe number of units for each text segment was 38, 38, 27, 21 respectively.

^bThe number of questions for each text segment was 8, 9, 8, 9, respectively.

Table 3

Results of Stepwise Regression Analyses using Recall and Question Performance as Criterion Variables and Reading Comprehension Test Scores, Knowledge Condition, and Text Coherence Condition as Predictor Variables

Criterion Variables	Predictor Variables	R ²	Statistical Value
Recall	Reading Comp	.253	F(1, 131) = 44.46, $p < .01$
	Text Coherence	.343	F(2, 130) = 33.95, $p < .01$
	Knowledge	.372	F(3, 129) = 25.51, $p < .01$
Question	Reading Comp	.232	F(1, 131) = 39.52, $p < .01$
	Text Coherence	.386	F(2, 130) = 40.78, $p < .01$
	Knowledge		NS

Table 4

Model Responses to Questions Answered by 50% of Each Group

No Taxation Without Representation

Questions	Original 1 (Revision Study)	Original 2 (Present Study)	Revised 1 (Revision Study)	Revised 2 (Present Study)
•What does it mean that the colonists were not members of Parliament?	10%	8%	38%	46%
•Who is being asked to pay taxes?	•Colonists are being asked to pay taxes 53%	•Colonists are being asked to pay taxes 92%	•Colonists are being asked to pay taxes 71%	•Colonists are being asked to pay taxes 88%
•Why are they being asked to pay taxes?	28%	30%	9%	21%
•How do the colonists feel about the taxes?	48%	•Colonists are very upset about taxes 79%	•Colonists are very upset about taxes 71%	•Colonists are very upset about taxes 96%
•Why are the colonists upset about the taxes?	8%	13%	16%	33%
•What does "no taxation without representation" mean?	13%	17%	40%	•No Tax. Without Rep. means they wouldn't pay taxes if they were not part of the gov't 54%
•Why are the colonists refusing to buy British goods?	21%	40%	40%	48%
•What did the British do next?	15%	13%	33%	38%
•Why did they [take that action]?	8%	8%	27%	4%

Table 4

Model Responses to Questions Answered by 50% of Each Group (continued)

Boston Tea Party				
Questions	Original 1 (Revision Study)	Original 2 (Present Study)	Revised 1 (Revision Study)	Revised 2 (Present Study)
•Why was there still a tax on tea?	20%	13%	4%	42%
•How did the colonists feel about this tax?	•Colonists didn't like the tea tax 68%	•Colonists didn't like the tea tax 65%	•Colonists didn't like the tea tax 87%	•Colonists didn't like the tea tax 71%
•Why were they upset about a small tax?	25%	33%	44%	46%
•After the price of tea was lowered, what did the colonists do?	38%	46%	•Colonists refused to buy or serve tea after the price was lowered 84%	•Colonists refused to buy or serve tea after the price was lowered 75%
•What was the Boston Tea Party?	•BTP was the colonists' throwing tea into the water 73%	•BTP was the colonists' throwing tea into the water 92%	•BTP was the colonists' throwing tea into the water 80%	•BTP was the colonists' throwing tea into the water 80%
•Why did they throw tea into the water?	28%	38%	49%	•Colonists threw tea in the water because they were protesting the tax 58%
•Who took part in BTP?	•Colonists took part in the BTP 50%	•Colonists took part in the BTP 83%	•Colonists took part in the BTP 78%	•Colonists took part in the BTP 88%
•Who were the Sons of Liberty?	35%	38%	•Sons of Liberty were a protest group of colonists 67%	46%

Table 4

Model Responses to Questions Answered by 50% of Each Group (continued)

Intolerable Acts				
Questions	Original 1 (Revision Study)	Original 2 (Present Study)	Revised 1 (Revision Study)	Revised 2 (Present Study)
•How did the British feel about the BTP?	• British were very angry about the BTP 56%	• British were very angry about the BTP 88%	• British were very angry about the BTP 88%	• British were very angry about the BTP 90%
•What was intolerable?	15%	21%	40%	•British passed some laws for the colonists that were intolerable 67%
•What happened to the Port of Boston?	33%	25%	•Port of Boston was closed by the British 56%	•Port of Boston was closed by the British 58%
•What happened when the Port of Boston was closed?	23%	21%	•Ships could not go in or out/food and supplies were hard to get 56%	•Ships could not go in or out/food and supplies were hard to get 75%
•Why did they close the Port of Boston?	15%	25%	36%	•British closed the Port to punish the people of Boston 50%
•What does it mean that no self-government was allowed?	15%	25%	27%	•No self-government means that a place doesn't have the right to run its own government 63%
•What did the people of Boston do about this?	30%	21%	29%	33%
•How did the people in the other colonies feel about what was happening in Boston?	25%	21%	36%	•People in the other colonies were afraid that Britain would come after them next 63%
•What kind of help did the other colonies send?	8%	17%	42%	•Other colonies sent food and supplies to Massachusetts 50%

Figure Captions

Figure 1. Percentage of Units Recalled by Students in the Present Study.

Figure 2. Percentage of Questions Answered Correctly by Students in the Present Study.

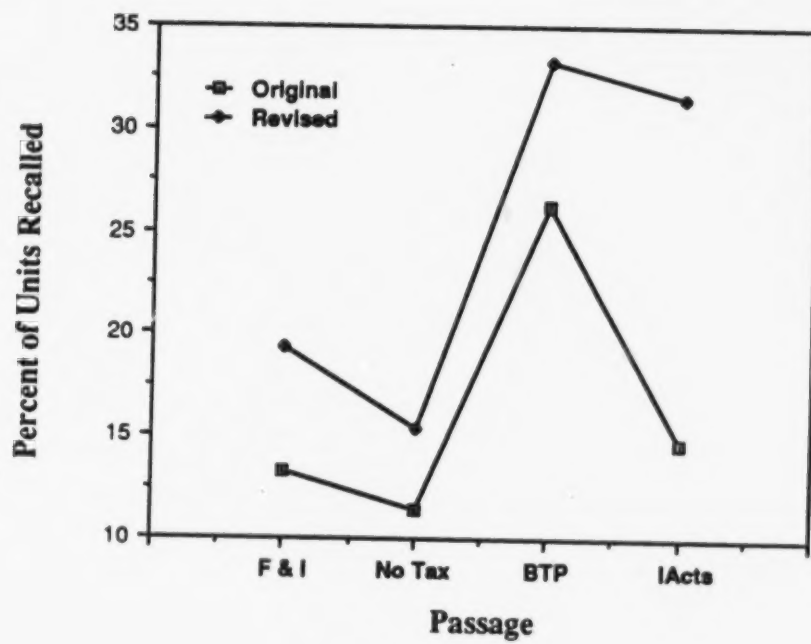


Figure 1.

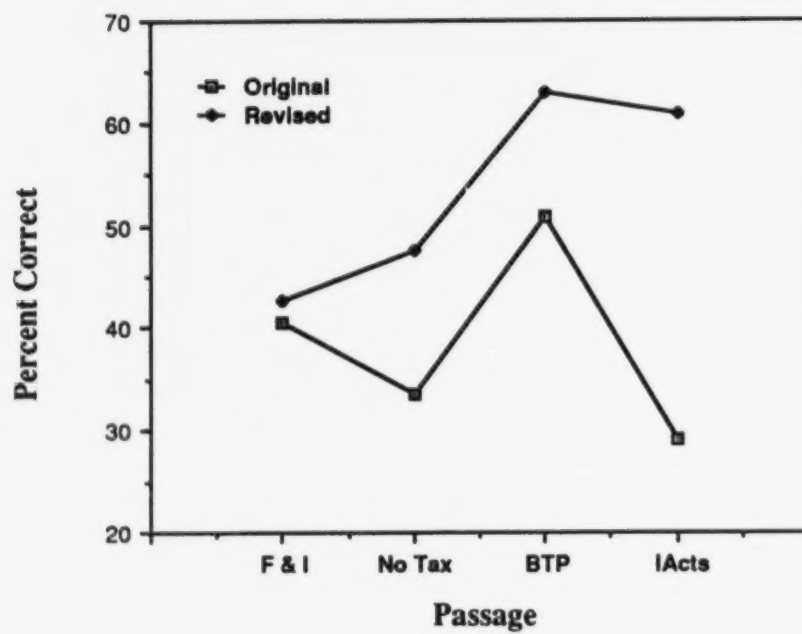


Figure 2.